



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|--------------------------|------------------|
| 10/710,828 | 08/05/2004 | Daniel C. Edelstein | FIS920040159 | 4827 |
| 30743 | 7590 | 06/29/2006 | EXAMINER | |
| WHITHAM, CURTIS & CHRISTOFFERSON & COOK, P.C. 11491 SUNSET HILLS ROAD SUITE 340 RESTON, VA 20190 | | | PIZARRO CRESPO, MARCOS D | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2814 | |

DATE MAILED: 06/29/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/710,828

Applicant(s)

EDELSTEIN ET AL.

Examiner

Marcos D. Pizarro-Crespo

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 May 2006.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 10-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7 is/are rejected.
- 7) ☒ Claim(s) 8 and 9 is/are objected to.
- 8) ☒ Claim(s) 1-20 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 May 2006 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

Application/Control Number: 10/710,828 (Final Rejection)
Art Unit: 2814

Page 2

Attorney's Docket Number: FIS920040159US1 (00750492AA)

Filing Date: 8/5/2004

Claimed Foreign Priority Date: none

Applicant(s): Edelstein et al.

Examiner: Marcos D. Pizarro-Crespo

DETAILED ACTION

This Office action responds to the amendment filed on 5/8/2006.

Acknowledgment

1. The amendment filed on 5/8/2006, responding to the Office action mailed on 2/7/2006, has been entered. The present Office action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office action are claims 1-20.

Election/Restrictions

2. This application contains claim 10 drawn to an invention nonelected with traverse in the election filed on 12/12/2005. A complete reply to the final rejection must include cancellation of the nonelected claim(s) or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Drawings

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character **120** has been used to designate both a conductor (see, e.g., par.0033/II.3) and a trench (see, e.g., par.0021/II.9).

Art Unit: 2814

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: **320** (see, e.g., fig. 3) and **730** (see, e.g., fig. 9).

5. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement-drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the examiner does not accept the changes, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1-5 are rejected under 35 U.S.C. 102(e) as being anticipated by Li (US 6955986).

8. Regarding claim 1, Li shows (see, e.g., fig. 1) all aspects of the instant invention including an integrated circuit including:

- A first layer **104** having a metal or metal alloy **102** at a surface thereof
- A second layer **108** adjacent to said surface having a metal or metal alloy via therein
- An interlayer connection between the metal/alloy of the first layer and the metal/alloy via

wherein the connection comprises a stable alloy region that has graded mechanical characteristics, contains a predetermined quantity of alloying material, and is restricted to an interfacial region of the metal/alloy of the first layer and metal/alloy via by a barrier layer (see, e.g., col.5/ll.15-28).

9. Regarding claim 2, Li shows the metal/alloy of the first layer is a first metal and the metal/alloy of the second layer is a second metal (see, e.g., fig. 1).

10. Regarding claim 3, Li shows the metal/alloy comprises copper (see, e.g., col.4/ll.23).

11. Regarding claim 4, Li shows the barrier including a layer of tantalum, tungsten, or titanium or alloys or nitrides thereof (see, e.g., col.5/ll.13).

12. Regarding claim 5, Li shows the barrier comprising a layer of tantalum nitride and a layer of tantalum (see, e.g., col.5/ll.13).

Claim Rejections - 35 USC § 103

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

Art Unit: 2814

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

15. Claims 1-4, 6, and 7, are rejected under 35 U.S.C. 103(a) as being unpatentable over Besser (US 6633085) in view of Lopatin (US 6368961).

16. Regarding claim 1, Besser (see, e.g., fig. 7) shows most aspects of the instant invention including an integrated circuit including:

- A first layer **30** having metal or metal alloy at a surface thereof
- A second layer **34** adjacent to said surface and having a metal or metal alloy via **52** therein
- An interlayer connection between the metal or metal alloy of the first layer **30** and the via **52**

wherein the interlayer connection comprises a stable alloy region **50** restricted by a barrier layer **46** to an interfacial region between the metal or metal alloy of the first layer **30** and the via **52**. Besser, however, fails to show the stable alloy region **50** having

Art Unit: 2814

graded mechanical characteristics. Lopatin (see, e.g., abstract/ll.6-10), on the other hand, teaches that providing said graded mechanical characteristics to Besser's alloy region would simultaneously provide the alloy region with good adhesion to both the barrier layer **46** and the copper via **52**.

It would have been obvious at the time of the invention to one of ordinary skill in the art to provide Besser's alloy region with Lopatin's graded mechanical characteristics to provide the alloy region with simultaneous good adhesion properties to both the barrier and the copper via.

17. Regarding claim 2, Besser shows the metal or metal alloy of the first layer is a first metal **30** and the metal or metal alloy of the second layer is a second metal **52** (see, e.g., fig. 7).

18. Regarding claim 3, Besser shows the metal or metal alloy comprises copper (see, e.g., col.4/ll.51).

19. Regarding claim 4, Besser shows the barrier includes a layer of tantalum nitride (see, e.g., col.5/ll.54).

20. Regarding claim 6, Besser shows the metal alloy of the interlayer connection at said interface includes tin (see, e.g., col.5/ll.17).

21. Regarding claim 7, Besser shows the barrier **46** is above the interlayer connection and the metal alloy of the interlayer connection **50** is confined to a region below the barrier **46** (see, e.g., fig. 7).

22. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Besser in view of Lopatin and Wang (US 6884329).

23. Regarding claim 5, Besser shows most aspects of the instant invention (see, e.g., paragraph 12 above). Besser also shows that the barrier may be tantalum or tantalum nitride (see, e.g., col.5/ll.54). He, however, fails to show the barrier including both a layer of tantalum and a layer of tantalum nitride. Wang (see, e.g., col.5/ll.46-50), however, teaches that using both, tantalum would act as an adhesion layer and tantalum nitride as a barrier layer.

It would have been obvious at the time of the invention to one of ordinary skill in the art to have Besser's barrier comprising a layer of tantalum and a layer of tantalum nitride, as suggested by Wang, to have a copper diffusion barrier layer functioning as both an adhesion and a barrier layer.

Allowable Subject Matter

24. Claims 8 and 9 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

25. Applicant's arguments with respect to claims 1-7 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

26. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

Art Unit: 2814

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

27. A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

28. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. Papers should be faxed to Art Unit 2814 via the Art Unit 2814 Fax Center. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

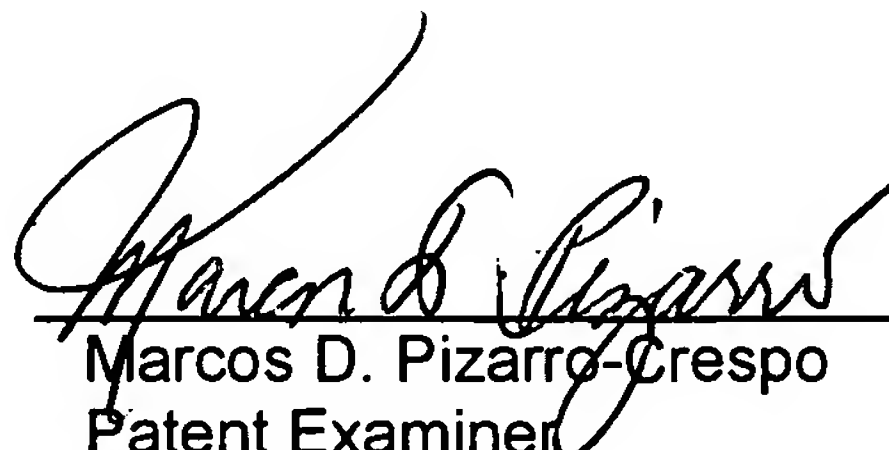
29. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Marcos D. Pizarro-Crespo** at **(571) 272-1716** and between the hours of 9:30 AM to 8:00 PM (Eastern Standard Time) Monday through Thursday or by e-mail via Marcos.Pizarro@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (571) 272-1705.

Art Unit: 2814

30. Any inquiry of a general nature or relating to the status of this application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

31. The following list is the Examiner's field of search for the present Office Action:

| Field of Search | Date |
|--|-----------|
| U.S. Class / Subclass(es): 257/750-766 | 6/10/2006 |
| Other Documentation: | |
| Electronic Database(s): EAST (USPAT, EPO, JPO) | 6/10/2006 |


Marcos D. Pizarro-Crespo
Patent Examiner
Art Unit 2814
571-272-1716
marcos.pizarro@uspto.gov